VHFER

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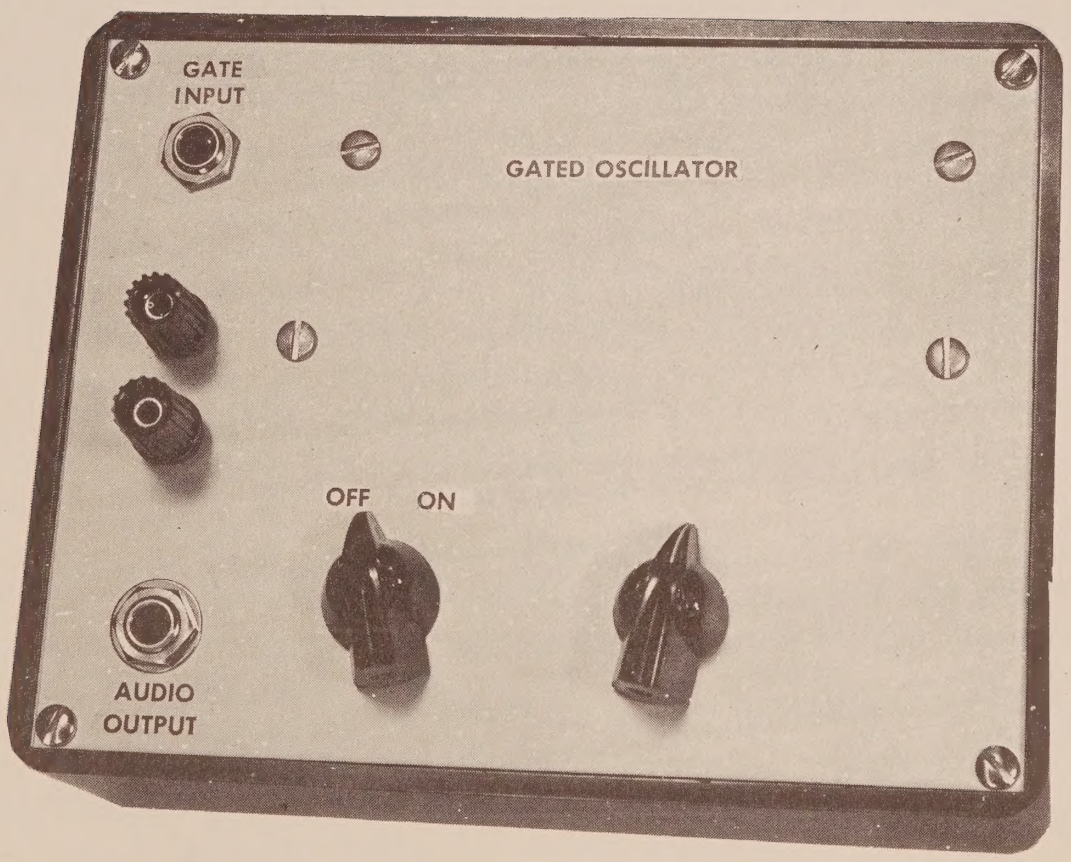
Volume 4, No. 5 May-June 1966



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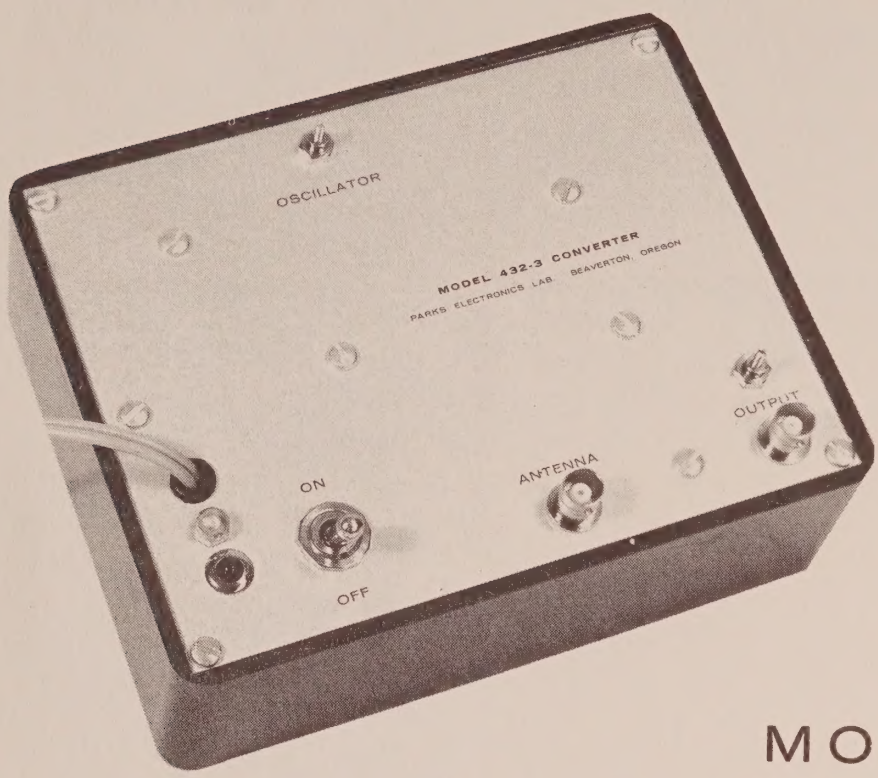

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Moonbounce Newsletter

by Victor A. Michael, W3SDZ
Box 345, Milton, Penna.

As a snowball increases in size, so has the number of people making an attempt to work VK3ATN on Two Meter moonbounce. This has come about due to the fact that Ray has built himself a super duper 144 Mc array down in Birchip, Victoria, Australia. The array is of the rhombic type with leg lengths in excess of 300 feet. Not only does Ray have one rhombic like this, but he has stacked four of them one above the other. Ray had to go to a really large, high-gain antenna because of a 150-watt input power limit in Australia. Ray can now hear his echoes very loud when the moon reaches a Greenwich Hour Angle of about 148 to 150 degrees and a declination of North 23 to 24 degrees. I have listed in the column a table of his schedules. While four days are listed each Lunar Month, presently only one or two days are best for schedules when the declination is between 23 and 24 degrees, but Ray is working on a system to steer the rhombics slightly so that the antenna will be usable for the full four days. The best place to get information about VK3ATN's activity is on twenty meters Thursdays at 1100 GMT on a freq. of 14.315 Mc. If twenty isn't open we go to forty meters at 1130 GMT with Ray transmitting on 7.090 and stateside stations around 7.227 to 7.230. SSB used on all schedules.

Presently I know of efforts that involve 512 elements at W1BU, 256 Elements at K6MYC and a 48 foot by 48 foot parabolic section by W6YK. Presently we are experimenting with long helical beams. I have built one 34 foot job which we are evaluating--if it comes up to it's theoretical performance, we intend to build three more and phase the four placed in line on a north-south line. Each unit will be mounted separately on its own ten-foot mount. I hope this will prove to be a workable antenna, as it was easy and inexpensive to build and mount the first one. I will have more on this antenna if it proves out. By the way the array will be steerable over at least a couple of hours on both the eastern and western horizon, but will take some work to rig it from east to west. At present it will be rigged for work on my western horiz. and up to about 35 degrees above it.

If you are playing around with antennas for moonbounce work, you may be interested in looking at things like sun noise and other cosmic sources. I personally have become quite interested in the possibility of using my own dish for some cosmic measurements which can give a better indication of antenna calibration and antenna gain than the sun. In some correspondence with Paul W4HHK, he sent me a table I'm reprinting in the column which may be of interest.

W6NLZ has written that he is currently hooking up his 1296 gear to his 18 foot az-el mounted dish. John says everything works fine, but now has to get proved out in the system. If you have any interest in 1296 work, John and the HB9RG group are the best prospects at this time. I may be able to move the system here at W3SDZ up to 1296, but I have been working virtually alone and there is a limit to how much I can get done. We are currently working on Two Meters, but you can be sure we will go to any band where there is activity. If you are doing anything, be sure to write.

COSMIC AND SOLAR NOISE *

Cosmic and solar noise levels for a half-wave dipole receiving antenna: **

Ideal Receiver (reference point):	0 DB	Note: From Fig. 2, Reference Data for Radio Engineers, 4th Edition, Int. Tel. & Tel. Corp.
Galactic Plane:	- 6 DB	
Disturbed Sun:	-12 DB	
Quiet Sun:	-22 DB	
Cassiopeia:	-40 DB	

Galactic Plane: Cosmic noise from the galactic plane in the direction of the center of the galaxy. The noise levels from other parts of the galactic plane are between 10 and 20 decibels below the levels given above.

Quiet Sun: Noise from the "quiet sun"; that is, solar noise at times when there is little or no sunspot activity.

Disturbed Sun: Noise from the "disturbed" sun. The term disturbed refers to times of sunspot and solar-flare activity.

Cassiopeia: Noise from a high-intensity discrete source of cosmic noise known as Cassiopeia. This is one of more than a hundred known discrete sources, each of which subtends an angle at the earth's surface of less than 30 minutes of angle.

The levels of cosmic and solar noise received by an antenna directed at a noise source may be estimated by correcting the relative noise levels with a half-wave dipole (from Fig. 2) for the receiving-antenna gain realized on the noise source. Since the galactic plane is an extended nonuniform noise source, free-space antenna gains cannot be realized and 10 to 15 decibels is approximately the maximum antenna gain that can be realized here. However, on the sun and other discrete sources of cosmic noise, antenna gains of 50 decibels or more can be had.

* Reference B. Lovell and J.A. Clegg, "Radio Astronomy", John Wiley & Sons, Inc., New York, N.Y.; Chapman and Hall, Limited, London, England: 1952. Also, J. L. Pawsey and R. M. Bracewell; "Radio Astronomy", Clarendon Press, Oxford, England; 1955.

** Copied from Fig. 2, P. 764, Reference Data for Radio Engineers, 4th edition, by Int. Tel. & Tel. Corporation

VK3ATN MOONBOUNCE SCHEDULES

			Base Time		Declination
July	15	-	2003	-	25° 32"
	16	-	2108	-	26° 44"
	17	-	2205	-	26° 00"
	18	-	2305	-	23° 20"
August	11	-	1734	-	24° 24"
	12	-	1849	-	26° 30"
	13	-	1949	-	26° 43"
	14	-	2043	-	25° 00"

To use table: Schedule Time begins 17 minutes before Base Time, and continues for 30 minutes.

VK3ATN's Operating Procedure:

He transmits on 144.090 Mc on the odd two minute periods of each hour regardless of the schedule starting times. Ray listens to pre-arranged scheduled frequencies during the even two minute periods.

144 MC. SPORADIC E OPENING

Shelby Ennis, W4WNH of Germantown, Ky. writes "I've finally heard my first E_S sig. on 144 MHz. E_S has been pretty strong on TV here several times--on 28 May, 1 June, and 6 June. On each of these days I put the V beacon tape on 144.100 MHz. But today, June 6, it broke loose.

At 1300 Z I had the usual 15-min MS sked with W4AWS in Fla. I received 25 S1s, 6 S2s, about normal for this time of year. At 1707 Z I put on a CQ tape, since E_S was so strong on TV. W8KAY was weakly calling CQ south, so I put in a landline call to W4AWS & told him to listen on 144.300, as the skip seemed to be north-south. W4AWS said that he had been seeing Canadian stations on TV earlier. At 1727 I called W8KAY on 144 & told him to listen for W4AWS on .105. As we were signing, W4AWS called back on landline with W8KAY an S9 there. They quickly worked at 1733. I worked W4AWS via E_S at 1744 Z, his sigs a little weaker here than while he had been on with W8KAY, but still S7. Then W8YIO worked W4AWS. W8YIO had worked WØJYC via E_S on 1 June while W8KAY & I didn't hear a thing at 1700-1730 Z.

No other signals were heard and I couldn't get anyone else on. Even TV folded up about 1830 Z. But W4AWS was S9 for 10 minutes here, and readable for almost 30 minutes. "

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COMMENTS ON 1296

by Peter Laakmann, WB6IOM*

1296 Mc. offers some rather interesting possibilities and will probably see much more activity in the future. For those who want to go all out it probably is the easiest band to try moonbounce on, since the antenna aperture requirements are less. These were the thoughts I had when I started building about a year ago.

I am now to the point where the transmitter is in good shape, and will tackle the parametric amplifier and antenna in that order in the future. I felt that this was the time to share my experiences and thoughts with others. Perhaps they will be of help to those of you ready to tackle this band.

First of all, let's talk systems. Going SSB (linear) in the beginning will save a lot of rebuilding in the future. What happened on the lower bands is going to repeat on 1296, so why not take the step in the beginning. If you have an exciter (SSB) available it is realy easier this way, since all you will have to worry about is RF. Also, if you go linear there is only one multiplier chain to be built for your station. This is because your I.F. can be equal to your transmitter injection frequency.

Let's not kid ourselves, this is no band for an overtone rock. You only have to build one oscillator, so build a good one. Don't try to save money here. Use transistors, a low-frequency crystal, low power dissipation, and either put it into a proportional oven, or if you like garden work, bury it.

Now as far as frequencies go, I found a good one: 6.604166 Mc. There may be others, but this one has some rather attractive features. It comes out at 1268.000 Mc. There are no TV channels on the way up to disturb your peace. But here is the bonus: somewhere along the chain you can tap 158.5 Mc. If you have an exciter delivering at 28 and 14 Mc. you can work both 1296 and 144 Mc. This is unusual, since our bands are related harmonically but the injection frequencies for linear operation are not. Now, the 1268 output can drive your linear mixer and also tickle the 1N21 diode in your converter.

At first I was generating about .5 watt up there from a varactor quadrupler. This drove a varactor mixer to about 50 milliwatts output. Things really worked fine. With 2 stages of 2C43 amplification it delivered about 5 to 10 watts output. However, I wanted more power and when I got to about 100 watts output, I never really knew whether I was amplifying or oscillating at any one time. It began to dawn on me that I wasn't going to solve this one. You can't stop cavities from leaking, and you can't shield effectively up there without affecting your air circulation. Another point I want to bring up: varactor multipliers are bad enough, but when you couple them to a varactor mixer, most of the time you have a parametric oscillator. If this does not happen, the contraption is only linear under very unusual circumstances. There are good reasons for this, the most important one being that the load presented to the multiplier is not constant. Anyway this whole thing was a fiasco, and I ended up becoming extremely prejudiced against solid state up there and varactors in particular. Tubes looked better to me the more time I spent with that solid-state mixer. Since the answer as far as the regeneration is concerned is a higher-powered mixer, with less amplification afterwards, tubes are the only possibility anyway. (next page)

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The next thing I tried was a 2C39 cavity I took from a DME set that I got through Jay, W6GDO. I set it up like an ordinary plate modulator, driven at 1268 Mc. with about 10 W and modulated with about 70 W at 28 Mc. It takes a lot of air to keep it cool, but it does deliver about 10 W at 1296. Unfortunately this cavity is not very sharp, since it was designed for pulse service. The 1268 component is still only about 10 db down. This is OK if you go directly into the antenna from there.

Remember, this is a big band. The unwanted components are all contained within our band. However, if you drive another amplifier with it, you'd better filter the output. Otherwise the amplifier will rectify the signal and produce an enormous amount of 56 Mc. components. Enough in my case to drive my own TV set completely black on Channel 2. I am using a square cavity about 4.50 inches on the diagonal as a filter. Now when it came to devising a more permanent way of generating 10 watts on 1268 to drive this mixer, I couldn't overlook a 1N4388 in my junk box that was supposed to do it. I know this is a varactor, but I was willing to give it another try. It certainly is an easy way out, I thought. Well anyway, that diode is still in my transmitter. It did not show more than the usual jumping effects. With a big air-cooled heat sink on it, it is almost as stable as a tube. Drive for the varactor is about 25 W from a grounded-grid 2C39 at 317 Mc.

The amplifier I mentioned earlier, which follows the mixer, is a dual 2C39 in a square cavity. I won't go into details on this one now other than to say that it is all sheet metal, and can be soldered together over a gas stove if you have a wife who tolerates such infringements on her domain. It will appear separately in the VHFER. This amplifier delivers around 100W output with about 250 W input.

So far things are inexpensive. If you have to pay for the next tube in the amplifier chain, it won't be. That tube is a 7650 or 7651. Either way it retails for around $300. I was lucky and got one free. I built a similar sheet metal cavity for it and it delivers upwards of 350 watts output. You see, the power gain of that tube is actually quite small and you won't need it unless you are serious about moonbounce in which case you can't do without it. It also takes an expensive high-pressure blower and good solid kilowatt supplies. If you want to keep the tube alive, some fancy interlocks and temperature gauges are nice to have.

Now about temperature gauges. They can tell you some useful things about any VHF amplifier. Attach a thermocouple to the plate of the tube through a beryllium oxide or alumina washer. You can monitor cooling performance of your system, shut down the supplies automatically if the temperature is unsafe, measure power output quite accurately, and have another meter to watch.

If you are the tinkering type and like to design a cavity for a tube or tubes that you want to use, don't try to bypass the grid in a triode. Ground it. I tried bypassing on both the 2C39 cavity and the 7650. I have come to the conclusion that it can't be done. In a tetrode, ground the screen and bypass the grid. Before you even build such an amplifier you would know it couldn't oscillate. When you breadboard a cavity, use thin brass .015 thick, solder everything together, without bypass sheets, and use the present exciter and a flashlight bulb to find resonances in the input and output cavities. When things tune right, take down the dimensions and build it out of thick stock with bypass sections. This way you can design a brand new cavity in an evening.

Now about antennas. If you have a dish of 4 feet or larger diameter, use it. But there

is little point in using dishes smaller than this. I believe a simple helical antenna a couple of feet long will do better. These can be built out of bamboo and #12 wire or clothesline. I don't know what I am going to use for moonbounce yet. I am still considering a large array of self-supporting helixes. Let's adopt a standard on helixes for ground-to-ground work. There is no preference for any particular polarization as long as everybody is using the same. So lets make it left circular (counterclockwise twist when looking in the direction of the helix.) End.

ODDS & ENDS
by K7AAD

The weekend of June 18, VK3ATN copied K6MYC for 14 minutes on 2 meter moonbounce . Got complete calls and signals were 5 to 6 db over the noise. MYC heard only letters---no complete calls. MYC's rig runs 500 watts and the antenna is a 256 element colinear with a transistor preamp mounted on it. W1BU is hard at the 2 meter moonbounce with a 128 element colinear. Info from W3SDZ.

You will note that there are two primary trends now in VHFER and supposedly among the more advanced hams. One trend is toward moonbounce, the other is toward 1296. I have been holding WB6IOM's article for a 1296 amplifier because I have nothing to drive it and probably you are in the same boat. I think we'll get it in next time.

VHFER articles in the past have been mostly concerned with receiving equipment. I fully realize the problems of the average ham in constructing transmitters that are more than a few watts. The biggest one is metalwork. Some time ago I talked about furnishing metalwork kits for high powered finals, but talk is cheap. The nearest we came to it was Deane Kidd's 432 tripler kit. 'We'means W7UAB, W7UDM, K7ZIR and W7TYR plus myself. These guys work at Tektronix and know how to build nice equipment. When they get stuff built for themselves that works right, it is usually too complex to furnish as a metalwork kit. Some of the simply built stuff doesn't work easily enough that the average ham could build it and be sure of making it work right. So the net result is that little progress is made.

I took the 220 converter described in the last VHFER to the VHF conference in Santa Barbara last month. I gave it to K6IBY of Costa Mesa to test for us because he is active on 220 and in an area that is really loaded with every kind of r.f. imaginable. Joe thought the biggest problem with it was that it needed more selectivity in the front end--probably a cavity filter or another r.f. stage with low gain. He thought it could use more gain too. I believe this is a variation in receivers. We had enough gain here to cover receiver noise or we wouldn't have been able to make the low noise figure. Probably there wasn't enough reserve. One of the problems at 220 is the neighbors' TV sets when they're watching channel 7. Local oscillator radiation. Sensitivity was good and there were no detectable birdies. Hank Meyer, W6GGV (who designed the converter) had two r.f. stages in it and we took one out. He said he would probably design a cavity filter for it.

Any of you planning to come to the northwest coast this summer ought to be told a bit about our summer climate. Portland and Seattle areas can have rain frequently thru July. Our nicest weather is often late August, Sept. and Oct. East of the Cascade mountains the weather is dry and more dependable (not exactly cool) but the mountain areas are very nice--no mosquitoes, no humidity, lots of lakes, good camping facilities. Expenses vacationing in Oregon are minimal if you have a tent or trailer. It just costs like everything to get here. No sales tax. The 9% they hang on us pays the bill.

We are at last out of 6up in the bundles of 10 to 12. Just odds and ends which will soon be chucked because of the space they take. Even VHFER is in a sad state with Feb. out of the 1966 and a few missing from 1965. If you want them, 20¢ each postpaid. We'll fill the best we can and refund balance in stamps.

Please don't order any 432 transistor preamps. They just don't work well with the newer transistors and we haven't gotten around to re-designing it. Don't think the 432-2 is outmoded by the new converter. It's still OK. We cannot do modernizing of any converters or repair anything not in current production. Too expensive for us.

VHF QSO PARTY REPORT

We have only 3 reports in, all from the west coast. This doesn't mean we are soliciting more reports because they would be too old by the time they could be published. We'll leave that to the bigger magazines. But to show you what happened in the west the following are given:

K7AUO/7, the Tektronix club, went to 3,000 ft. Roundtop Mountain in the Coast range about 40 miles from Portland. They earned 3,940 points, much of it due to working WB6KAP and W6GDO on two meters and W6GDO on 432, a distance of 475 miles. Signals were not marginal, but good solid copy on both bands, strength being about equal. 2 contacts were made on 10KMHz, both distances of about 40 miles to 2 locations in the Beaverton area.

W6GDO in Sacramento reports: 50 Mc. 49 contacts, 13 sections. 144Mc: 77 contacts and 10 sections. 220 Mc: 8 contacts, 4 sections. 432 Mc: 18 contacts, 7 sections. 1296: 2 contacts, 1 section. Distances were 100 and 165 miles to K6HCP and W6GD/6 in the Santa Clara Valley section. Jay reports that 50 Mc. scatter contacts upped his sections on 50 Mc. considerably.

W6GGV in the L.A. area reported "Generally conditions were dismal with essentially no sporadic E to liven up 50 Mc. even though there were a few very short 50 Mc. openings from here. Tropo signals were extremely poor as witness W6GDO's low signal strength into the L.A. basin area. The real surprise was 220 Mc. activity with local mountain-topping operation working as many as 35 contacts in all California sections. I worked 12 stations in five sections in less than 2 hours. 432 activity suffered from the same relatively poor tropo condition. There were lots of stations but nothing spectacular happened. W6NLZ worked W6GD/6 on San Benito Peak on 1296 with signals being 3-3 on a 5/5 scale at the L.A. end and 2 "S" units better at the W6GD/6 location. John was running 1 KW to a 15' dish and the W6GD/6 operation was using 10 watts to a 4 foot dish."

COAX CABLE FOR THE VHF MAN

by Carl A. Ebhardt W4HJZ*
Ragchewer Magazaine

For years the RG-58, 59, and 8 U coax types have been widely used for amateur transmission lines. As amatuers push higher into the frequency spectrum the limitation of the popular RG type cables becomes apparent. At VHF and UHF the more popular types of coax leave much to be desired. Recently new types of coax cables have come onto the market but little technical information has been published in amateur journals.

Here in North Carolina some very high performance coax is being manufactured. The Superior Cable Company in Hickory and Rocky Mount is making the cable mainly for the CATV market. However, its price and performance are such that it is worth attention from the VHF man.

Mr. W. T. Smith and Mr. W. L. Roberts of Superior Cable presented a very informative paper at the Region 3 Annual meeting of the I.E.E.E. in Winston Salem, North Carolina, on April 7, 1965. They have given permission to pass this information along.

PARAMETERS OF CABLE DESIGN

In considering a coaxial cable design, it is more convenient to divide the cable losses into its three component parts: (1) the center conductor, (2) the dielectric medium and, (3) the outer conductor (also called return conductor or shield).

Center Conductor

Center conductor losses in a coaxial cable ordinarily dominate losses from other sources. Accordingly, copper is almost always the metal employed for center conductors. The cost of silver prohibits extensive use as a conductor even though a slight reduction in loss can be achieved.

Because of skin effects, high frequency losses require only a thin conducting surface to possess low resistivity. However, mechanical considerations often preclude use of thin shells (or tubing) of high conductive materials. Plated composite conductors solve mechanical problems but may not offer adequate low frequency conductivity.

Cable bending characteristics can generally be improved by use of a stranded center conductor but should only be used where flexibility considerations are paramount since high frequency losses are almost always fifteen to twenty per cent higher than with a comparable solid (or smooth surfaced) conductor.

Use of hollow tubing becomes economically feasible only with rather large conductors. Mechanically, tubing can be employed to achieve a reduction in stiffness only for very thin wall tubing. The tubing wall thickness must be less than ten per cent of its outer diameter to obtain even a fifty per cent reduction in stiffness compared to

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Raleigh, North Carolina

the solid rod. Then buckling characteristics may become the limiting factor. Generally for a center conductor of less than about one-fourth inch, solid copper is the best choice. For large cables (center conductors one-half inch or larger), tubing is more favorable cost wise.

Outer Conductor (Shield)

The return conductor must provide adequate shielding to confine the R.F. energy within the cable and certainly should contribute as little as possible to cable losses. The return conductor, in conjunction with possible supplemental coverings, also serves to physically protect the cable dielectric.

Braided shields are useful where repeated flexing will be encountered. However, they provide relatively poor radiation shielding (which can be improved through use of multiple braids) and have substantial R.F. losses particularly at frequencies around 200 Mcs. and up (which cannot be improved through use of multiple braids).

If the outer conductor is essentially a solid sheet, losses are little affected whether the sheet is a solid tube or an overlapped tape (smooth or corrugated) so long as the tape is electrically thick and does not radiate noticeably at any seam or overlap present. Higher resistivity materials such as aluminum tubing can be used with minimal effects on cable losses, primarily because of cable geometry, i.e., the cable diameter is large compared to the center conductor.

A return conductor tape can be formed around the cable core by a process which allows continuous cable length to be produced economically. The edges may be butted or overlapped and the position may be maintained by virtue of additional coverings, by natural stiffness and "set" in the tape, or by sealing the seam through welding or other techniques.

It has been found that effective shielding in the VHF band may be attained with an overlapped tape if the lap is maintained without substantial gaps. Compared to a braided shield, about a 30db improvement in shielding effectiveness is obtained with an overlapped corrugated copper shield.

Corrugation of a shield in a suitable fashion immediately transforms an otherwise rigid, easily buckled shield, into a member which can be bent without specialized bending techniques. For ease in installation and future system reliability, it is desireable to corrugate a solid (tape or tube) shield if at all possible.

If the dielectric medium inside the shield is susceptible to moisture and other environmental effects, protection must be supplied by the shield and/or additional outer protective coverings. In many cases, an extruded non-metallic covering affords the required protection. In the case of a cable buried in permanently wet soil, additional protection offering a permanent hermetic seal may be necessary--if the cable dielectric is susceptible to moisture vapor effects.

Whatever technique is used, the diameter of the coaxial cable outer conductor must be maintained very uniform. Even extremely small diameter variation, if systematic, can give rise to impedance deviations at particular frequencies.

Dielectric

Low permittivity dielectric materials permit use of larger center conductor diameter for a given cable diameter and characteristic impedance. Air, with a permittivity of one, is a most desirable dielectric but some means of supporting the center conductor has to be added. Judicious use of support materials can result in a composite dielectric with a dielectric constant only slightly greater than one. The disc-insulated coaxial cable and, of more recent vintage, the balloon coaxial cable represent the most popular current techniques for obtaining dielectrics with a constant of 1.1 or below. Solid polyethylene has a dielectric constant of about 2.3 but offers the advantage of ruggedness and stability in the presence of moisutre, without auxiliary protection techniques such as hermetically sealed sheaths and pressurization techniques. Foamed polyethylene has become quite popular. It has a dielectric constant of about 1.5 and shows very good moisture stability in aerial applications. Without a suitable hermetic seal against moisture permeation, it is not sufficiently stable for direct burial in wet locations.

The high volume market for coax cable with low loss at VHF is the C.A.T.V. industry. A cable impedance of 75 ohms has been almost universally adopted. The value corresponds to the value yielding minimum high frequency attenuation for a dielectric with a permittivity of one(1) and whose inner and outer conductors are of equal conductivity. Higher permittivity dielectrics used in a 75 ohm design are not optimum, but the penalty is not too severe.

Leakage or conductance in a dielectric material is not negligible at frequencies greater than 100 mcs even for the best currently used materials. In a 75 ohm cable, a dissipation factor of 0.00012 presents a loss of about 0.1db/100 feet at a frequency of 210 mcs. For a cable with this dissipation factor, and 1db/100 feet total loss at 210 mcs, this is a very noticeable contribution. Furthermore, high frequency attenuation instability is generally found to be associated with changes in dissipation factor--most commonly resulting from the presence of moisture.

Moisture has been found to cause a five-fold increase in dissipation factor in conventional foam polyethylene (initially about 0.00025) where exposure is continuous either immersed in water or in an environment of greater than 85 per cent relative humidity. Humidity levels below 85 per cent show only small effects on the normal dissipation factor. The major part of this increase apparently is a result of moisture interacting with residue of the chemical blowing agents which are used to foam the polyethylene compound.

Solid polyethylene compounds currently in use have a dissipation factor in the order of 0.0002 over the VHF band. These compounds show no significant change in dissipation factor in the presence of water or water vapor. Because of their ruggedness and stability, they represent a better choice than a lower loss but delicate and unstable material for many applications.

Disc insulated cables need protection by means of pressurization techniques or hermetically sealed coverings to prevent leakage paths developing to the outer conductor. Balloon insulated cables do not have the direct surface leakage paths to the outer conductor as found in the disc cable. The cells of the balloon dielectric can, by design, be closed for non-pressurized applications or they can be spaced to allow gas flow along the length of the tube.

TABLE #1

Type E Cat. No.	Inner Conductor	Dielectric Material	Outer Cord.	Nom. Dia. Overall	Impedance ohms	Loss in d/b/100 50mc	144mc	432mc	Factory/Minimum Cost/Qty. in feet
RG-58 A/U	19 Strands Tinned Copper	Solid Polyethylene	Tinned Copper Single Braid		52	3.6	6.5	13	4.2 ¢/foot 2500 feet minimum order
RG-8 A/U	7 Strands Copper	Solid Polyethylene	Copper Single Braid		52	1.5	2.6	5.4	8.9 ¢/foot 1000 feet min. order
RG-17 AU	Solid Copper	Solid Polyethylene	Copper Single Braid		52	.65	1.2	2.4	40.6 ¢/foot 2500 feet min. order
"Superior 4920"	Solid Copper	Foam Polyethylene	Copper .005 Tape Corrugated	0.480	75	.65	1.15	1.9	9.5 ¢/foot 2500 feet min. order
"Superior 6020"	Solid Copper	Solid Polyethylene	Copper .005 Tape Corrugated	0.650	75	.65	1.15	1.9	15 ¢/foot 2500 foot minimum order
"Superior 4930"	Solid Copper	Foam Polyethylene	Copper .005 Tape Corrugated	0.650	75	.54	.9	1.55	15 ¢/foot 2500 feet min. order
"Superior 6030"	Solid Copper	Solid Polyethylene	Copper .005 Tape Corrugated	0.870	75	.54	.9	1.55	25 ¢/foot 2500 feet min. order
"Superior 3/8 Balloon	Solid Copper	Air and Pinched Polyethylene Tube	Copper Tape .005 Corrugated	0.480	75	.52	.85	1.45	Price on request
"Superior 4920"	Solid Copper	Foam Polyethylene	Copper .005 Tape Corrugated	.870	75	.48 .35	.62 .7	1.1 1.32	35 ¢/foot 2500 Feet min. order

SIMPLE SUPER SELECTIVITY

Richard Turrin, W2IMU*

The human ear is an ingenious device and together with the brain form a marvelous audio receiving system. The system is basically broadband, encompassing a frequency range of some eight octaves. And yet it may be made extremely narrow band at the will of the operator without even turning a knob. Incredible, still most C.W. operators make use of this capability without understanding it and some simply are not disciplined enough to use it.

In the crowded amateur bands our ears are almost always subjected to more than one signal at a time; however, by concentrating on one of these signals it is possible to copy that signal provided that the QRM is not intolerable. The ear-brain system bandwidth may be reduced to the order of 50 cycles per second by concentration. You hear what you want to hear!!

In order to improve on the human sound detecting system a filter with bandwidth less than 50 cps must precede the ear. Possible, but difficult to use with the average transmitter-receiver frequency stability not to mention "ringing" of the filter. We can probably do better by leaving our receiver bandwidth set at one or two kilocycles and use our own built-in filter. Adjusting the b.f.o. for single-signal detection or making use of the single-sideband selectivity available in modern receivers is highly desirable since this reduces the QRM probability by one-half.

The 50 cps bandwidth of the ear-brain system seems incredible but is documented and may be easily demonstrated for a single tone in the presence of white noise.[1] Typically for a signal-to-noise ratio of unity, a pure tone in 3kc band limited noise would indicate a signal report of 569. A signal-to-noise ratio of -20 db or 100 times less signal power is barely discernable to a trained ear. In addition to being extremely narrow band, the ear-brain system is tunable over a range of about 200 to 1000 cycles with essentially the same bandwidth. Above and below this range the bandwidth increases. The system is therefore able to track a signal which is slowly drifting in frequency. It is interesting to note in connection with ear-brain bandwidth that a well trained musician can distinguish half-tones in the musical scale. A half-tone at 500 cps is about 30 cps.

It is also documented that two ears impressed with the same sound do better than one and that earphones degrade the system compared with a speaker in an acoustical chamber. A soundproof shack with sound absorbing walls is ideal, but alas earphones will reign in the average shack. A worthwhile investment would seem to be a comfortable pair of earphones with the properties of both good frequency response and low distortion.

The amplitude response of the ear is somewhat logarithmic and consequently will tolerate a wide dynamic range without overloading. The non-linear response how-

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[1]Acoustics by Leo L. Beranek, p 394.

ever, gives rise to distortion products which are invaluable to a piano tuner but a nuisance to a C.W. operator. Fortunately these distortion products are much weaker than the weakest of any two original signals, the only one of any consequence being the difference frequency.

Another point worth mentioning is the insipid desire of most operators to tune their receivers so that the desired signal is heterodyned to a frequency of 1000 cps or higher. Nothing could be worse for two reasons. First, the ear-brain bandwidth increases above 1000 cps; and second, it is far easier to separate signals which differ in frequency let us say by 100 cps by heterodyning the signals to as low a frequency as possible. Indeed, if the undesired signal is heterodyned to "zero-beat" there will be little difficulty copying the desired signal. And this can be most desirably accomplished by careful tuning of the receiver and NOT by fiddling with receiver selectivity or mistuning the b.f.o. Keeping in mind that the receiver r-f gain be kept low and the a-f gain up to minimize overload distortion within the receiver.

A few brief notes have been presented concerning the ear-brain audio detecting system. The relationship to receiver selectivity and the C.W. operator has been stressed with the aim of enlightening a few and reassuring others of their natural capability. The next time you are thinking of buying a more selective receiver, put a little of the thought concentration on the signal you wish to copy and you will save the money and become a better operator.

A GATED AUDIO OSCILLATOR

by Loren Parks, K7AAD

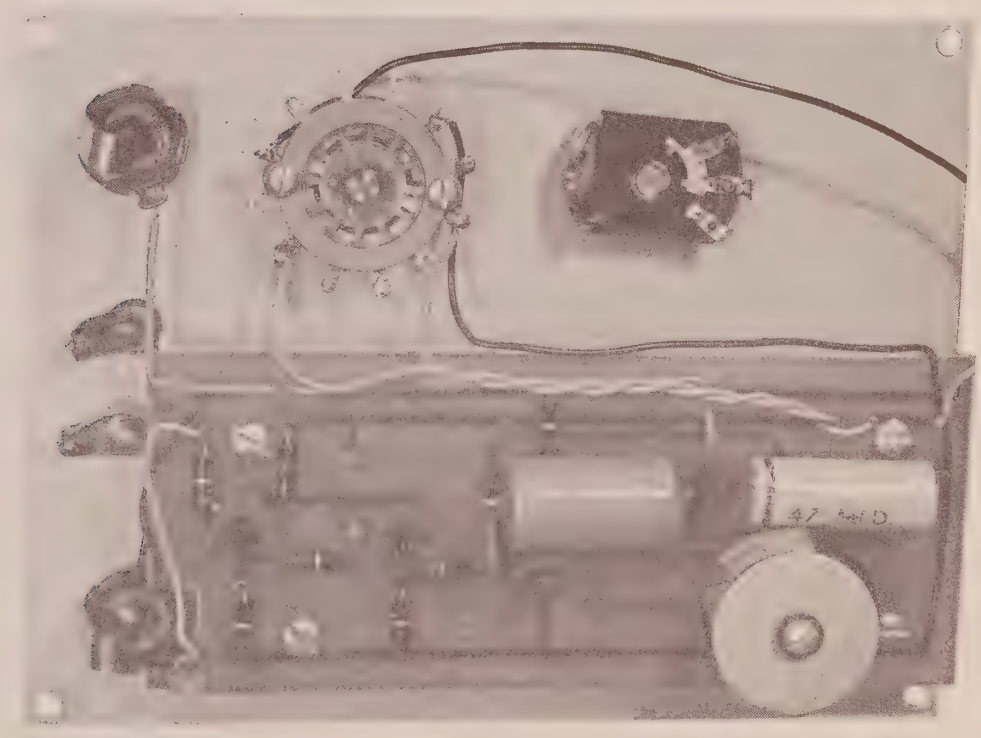
This article describes a simple audio oscillator which can be turned on and off by a gate, or change in a controlling input voltage. I built this device for weak-signal c.w. work---to give me a keyed audio note in response to slight changes in d.c. level. It worked very well, but unfortunately parts of the entire system didn't. The aim was to get a weak c.w. signal clearly readable via this gated oscillator and narrow-band power integration---a signal which was so weak that by ordinary methods it was only marginal copy or was so weak that I could do no more than determine it was there.

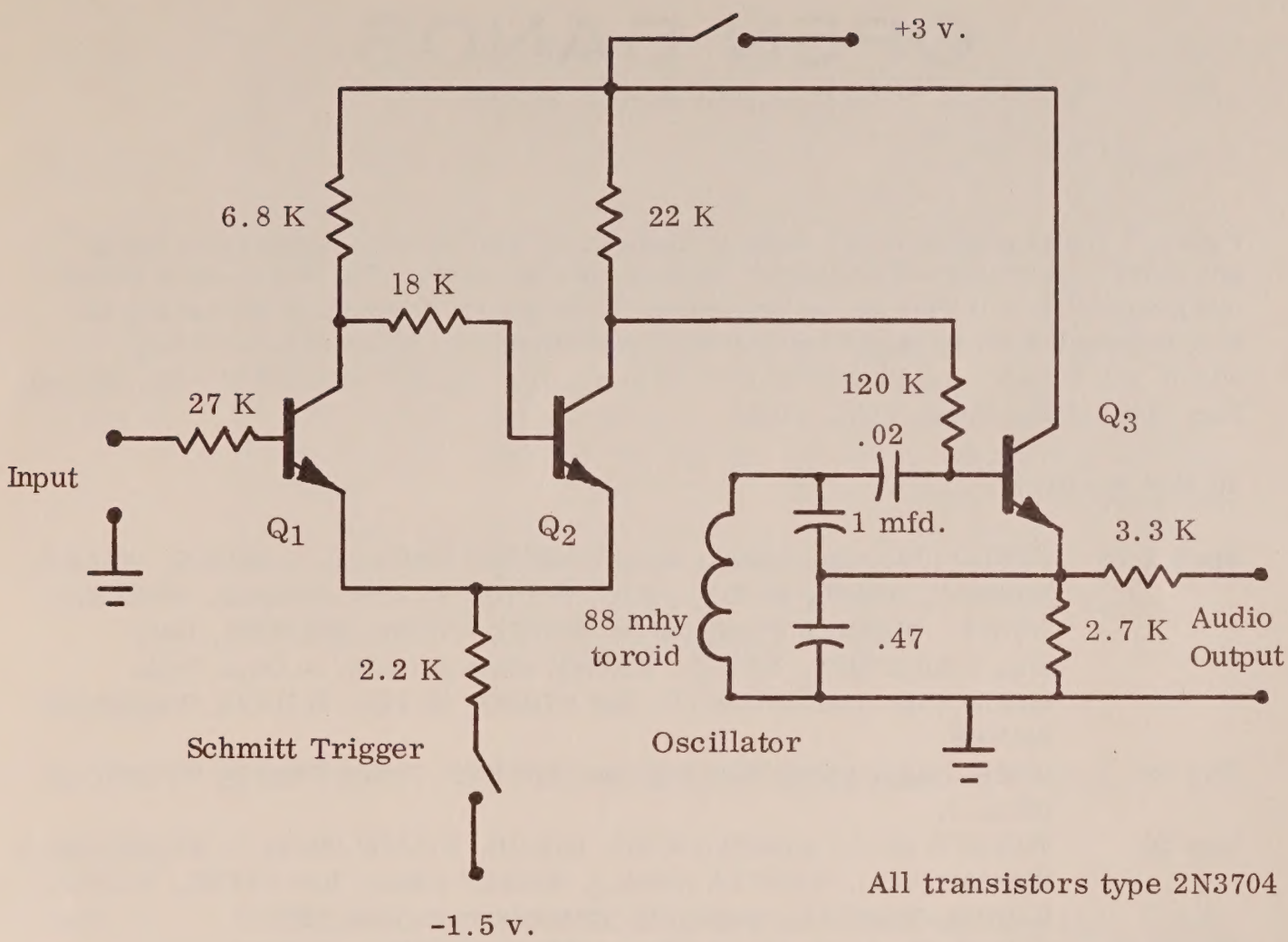
Let me digress for a paragraph and report what I see in my crystal ball. Extending VHF records, local or international, is the aim of many advanced VHF hams. Assuming you have the best in receiving equipment and the biggest (properly working) antenna you can put up, what then. You can go far into the noise in fairly wide bandwidth with a trained ear and a noise blanker or noise clipper. I believe the next step after clipping should be the very sharp audio filter, rectification, integration and gating. Now there are LOTS of problems, but I have succeeded in devising a simple system that would detect and read out on a meter the presence of a signal I absolutely could not hear. The stability and tuning problems are immense. My problem was in trying to AFC our 144-1 converter. Tuning is a BEAR. I wanted to devise a system to latch on to that weak signal and hold it. What I had worked just fair. It will take a re-designed oscillator and reactance modulator. A friend of mine reports success with FSK and a similar system and I believe his is inherently better than mine by 3 db. At any rate, this is what's coming and you need a gated oscillator if only to make weak signals much easier to copy.

The device has two parts: a simple audio oscillator and Schmitt's trigger circuit. The oscillator transistor, Q_3, is turned on or off by applying or removing forward bias on its base (the 120K resistor.) The collector of Q_2 (half of the trigger) swings between plus 3 and minus .5 volt. Some oscillators I've made do not like to turn off once they get going. This one is clean, probably due to the epoxy silicon transistor and back biasing. The TI 3704 is an inexpensive, high-performance VHF type we use as a workhorse. If you substitute, make sure the oscillator goes off and on without hesitation. You may have to juggle values.

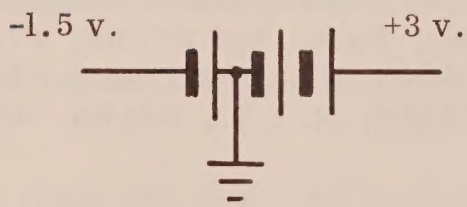
Q_1 and Q_2 make up the trigger, which is a decision maker. It has two stable states--Q_1 conducting fully and Q_2 turned off or vice versa. With the input at ground in my unit, Q_2 conducts heavily and the oscillator is therefore off. With an input voltage of plus .6 it goes on, at .47 plus it goes off. The voltage difference of .13 is called the hysteresis of the trigger. Fig. 1 shows the test set up for determining the on-off points. They will no doubt vary with different transistors. I juggled values to get suitable trigger points. The emitter resistor is quite important in establishing these points. 10 microamps of current at the input is required to activate the trigger. This means you should not drive this circuit with a high-impedance source if your are discriminating voltage levels as you would in the power integration described. The outside view of the device is on the cover. An inside view follows the text. One control is not yet connected. Binding posts are in parallel with the gate input jack.

Here are some figures on the effects of different source impedances. With a source of 22K it goes on at .83 volt, off at .71, hysteresis .12. With a 50K source on at 1.1 volt, and I forgot to record the turn off.





Gated Audio Oscillator



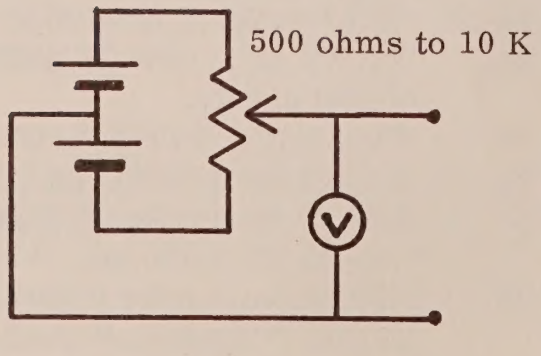


Fig. 1 Test set-up for determining trigger points.

OPEN BANDS

by Marilyn Wiseman, K8ALO

I guess I really goofed when I made the statement that "Nobody reads Open Bands any more". Reports and comments have proved me wrong. I'd like to thank everyone personally, but writing, housekeeping, a few hours of hamming and caring for four harmonics sure doesn't leave much spare time, so I guess this is the best way to say thanks. Looking forward to your report. See you next issue. My address: Box 103 Petersburg, Ohio 44454.

50 MHz Scatter:

April 2-30	K7BBO (Tacoma, Wash.) wrkd W6NZX/6 1300 mi., WB6GKK, W6ABN, WB6FSC, K6RIL, K6IBY, K6JC, K6UNR, W6CSB, W6NLZ, W6UXN, W6NIT. WB6GKK (Calif.) wrkd K6RIL, W6CSB, WA6RDX, Gary also wrkd K7ICW, K7RKH, WA6SQI while portable on Onyx Peak. K7ICW (Nev.) wrkd WØEYE, hrd K7BBO, K5TQP, W7UGO, W6NLZ, W6NVV.
May 24	W8JFI (Mich.) wrkd W4NUT, cw 1200 EST. W8JFT hrd by WØIRO (Minn.).
May 26	WB2KPD (N.J.) wrkd WA1CNG, K1ZGH, K1VOW (Mass.), K1OYB (Me.), WA4IAS (Va.), WA8FTA (Mich.), K8MLV (Ohio), hrd K1FRX, K1MTJ, K1HRM, WA3CAL, WA8MCC, K8MMM 1500-1900 EST.
May 1-31	K7BBO (Wash.) wrkd WØCUC, WØEYE, W7UFB, many stations in Calif. WB6GKK wrkd WØEYE, W7VGQ, WA7BTG, W7CNK, K7ICW, W5SFW, WA6SQI, Gary also had 16 QSO's with W5KCP, K7BBO 19 QSO's. K7ICW wrkd WØEYE, VE6OF, WØDPN, W5KCP, WA5CZM, WAØILH, W4CPX, VE4RE, also wrkd stations in Calif., Minn., Ia., British Columbia, Wash., hrd W7CNK, W7VGO, W5SFW, Calif., Tex., Okla., S.D., N.D., Neb., Kans., Me., Oreg., Mont., Idaho.
June 7	W8FTI wrkd K5AJW, R.T.T., W4LRN, WØEKM, WAØDUG, K6IBY, W6ABN.

144 MHz

April 3	K7ICW (Nev.) wrkd W6DQJ (Calif.) 0803 cw.
April 9	W4CKB (Fla.) wrkd W4UUF (Fla.) 425 mi. a.m.
April 10	K7ICW (Nev.) wrkd W6DQJ, K6JYO, W6NLZ, W6YVO 0808-0908 cw.
April 20-23	K7ICW (Nev.) hrd K7ZIR (Oreg.) 850 mi. M/S 0600-0700.
April 24	W4CKB (Fla.) wrkd W4VHH (S.C.) cw-a.m. 430 mi. This contact made almost nightly.
April 25	W4CKB (Fla.) wrkd W4LSQ (Ala.) cw.
April 26	W4CKB wrkd W4FJ (Va.) 750 mi. M/S full min. non shower burst.
April 28	K4SUM (Va.) wrkd W2NKO, W2IYW, WB2CYL. W8AXR (Ohio) wrkd W9BRA (Ill.) 480 mi. W3PGV (Pa.) wrkd K9CHS (Ind.).
April 29	K4SUM (Va.) wrkd WB2MTU, K2SWZ, WN2TOE, WB2JEP, WA2TOV, K2JNS, WA2UDV, W2LZZ. Joe said this was a good opening.
May 1	K7ICW (Nev.) wrkd K7ZIR (Oreg.) M/S cw 0930-1030. Al wrkd K7ZIR again at 2130-2140, also many Calif. stations.

May 14	W7JCU/4 (Ala.) wrkd W4SJF, W4WDH (Ga.) W5GVE/4 (Ala.) W5RCI (Miss.), W9AAG (Ill.) WA4LIP (Ala.). W5GVE/4 (Ala.) wrkd W5RCI (Miss.) 390 mi., W5IOW, W5UGO, W5WAX (Okla.) 750 mi.
May 15	WA8IDU (Ohio) wrkd K9SBP (Ill.) 539 mi., 0100 EST. hrd WØDQY (Mo.), 6 other 9's. W5GVE/4 (Ala.) wrkd W4IXC (Fla.) 380 mi.
May 18	W1AZK (N.H.) hrd W8WEN (Ohio) 2112 EST. 520 mi.
May 21	K7ICW (Nev.) wrkd K7ZIR (Oreg.) cw M/S 850 mi. 0900-1000. W5GVE/4 (Ala.) wrkd W4VHH. (S.C.).
May 31	W1AZK (N.H.) wrkd W9BRN (Ind.), W8PT (Mich.), K8WQA (Ohio), VE3DAW (Ont.).
June 2	K5PUG (Vivian, La.) hrd by U.S. Army Capt. a few miles north of Paris, France. Lem was calling CQ AM fone. Sig. S-9+10 running 522 Xmtr. 0200 C.S.T. This information sent to me by W5ML (La.) Art said it was sporadic E cloud very dense. He wants the sharp pencil boys to express an opinion.
June 6	W4AWS (Fla.) wrkd W4WNH (Ky.), W8YIO (Mich.) W8KAY (Ohio) 1230-1245 EST. This report sent in by W1AZK.

220 MHz

April 10	K7ICW (Nev.) hrd by K6IBY (Calif.) 260 mi. 2130-2200.

432 MHz

April 9	K7ICW (Nev.) wrkd W6PUZ/6 (Calif.) cw. This was first Nev. Calif. 432 MHz QSO. W6PUZ/6 running low output to 80 elm. Al running 5 W out to 44elem quad yagi. Al said W6PUZ/6 sig good also. W7QUK hrd K7ICW.
April 11	K4SUM (Va.) wrkd W2CCY (N.J.) 201 mi. Joe on am W2CCY cw.
Apr. 24-29	K4SUM, W4API (Va.) both wrkd W2CCY 201 mi., WB2EBM, WB2EGZ 150 mi.
May 14	W7JCU/4 (Ala.) reports hearing a number of signals on 432 at sunrise.

Sked Wanted

W5GVE/4 (Ala.) looking for skeds with Ohio. Bill's cw freq: 144.085 MHz.

W3GLC (Pa.) looking for skeds with N.S. Dakotas. Harry runs 500 w PEP 8/8 long john cw or SSB.

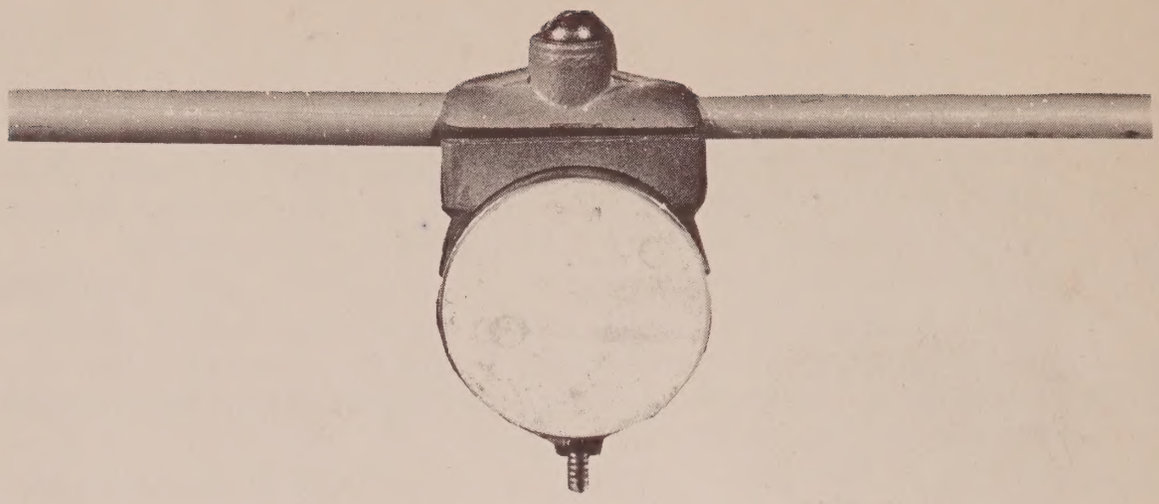
W4CKB (Fla.) looking for skeds with Ohio. Bev runs K.W. long yagi.

W1AZK (N.H.) looking for skeds with Neb., Kans., N.S. Dakotas.

W5ML (La.) looking for skeds N.E. North N.W. time 0630-0800, 2000-2200 144 MHz Motorola P.P. CX 250's cw freq: 144.035-144.090 MHz. 432 MHz CX 250 B 40 watts 32 elem 50'.

Information for Sept. VHF QSO Contest

KØMQS Dick and WAØFDY Al will be operating station WAØFDY/Ø near Wahpeton, N. Dakota. Freq: Transmit 144.210 MHz Rec. 144-145.5 MHz. Power: At least 500 w C.W. Fone as yet undetermined. Time: 1800 GMT Sept. 10 to 0400 GMT Sept. 12. For further info, both Dick and Al can nearly always be found on 7250 SSB between 0700-0900 local time Sunday mornings.



ANTENNA ELEMENT MOUNTS

If you like to build your own antennas, consider these mounts which will make your antennas more rugged and easier to build. An antenna made with these mounts is a whale of a lot easier to tune because you can change element spacing easily. Otherwise you have to drill big holes in the boom and just guess where the element would work best. Remember that on a Yagi there is an optimum element length and element spacing for maximum gain and a given element and boom size. Adjustment near the driven element is very critical. When you can move the elements along the boom and note the immediate effect on gain, you can easily see when you're getting somewhere.

Element mounts are in two pieces with holes in the middle that pass the mounting screw. Mounts are die-cast from Zamac and are iridite treated to resist corrosion. They are RUGGED. My 6-meter beam came down and broke the boom, but not the element mounts. I've never seen a broken one yet. The upper part has a V contour so it will fit snugly over elements from 3/16 to 3/8" in diameter. The bottom part fits 1 1/4" TV mast, available everywhere in 10-foot telescoping sections. The mounts will work well with 1 1/2" booms too. Choice of hole size for No. 8 or No. 10 machine screw. Four sets (to mount four elements) for $1 postpaid in U.S. & Canada. 25¢ for each additional set (to mount 1 element.)

Order from Parks Electronics Lab., 419 S.W. First, Beaverton, Ore. 97005

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